

Elective-II

**COLLEGE OF ENGINEERING PUNE-5**  
**Dept. of Electronics and Telecommunication**  
**Final Year B. Tech (E &TC)**  
**ET 413-2: Speech Processing (Elective-II)**  
**End Semester Examination**

Day and Date: **Wednesday, 23/4/2013**

Semester: **VIII**

Duration: **3.00 Hrs**

Maximum Marks: **50**

Instructions:

- i. All questions are compulsory.

- Q1 A** With a neat schematic diagram of human vocal system explain speech production mechanism. What do you mean by the term pitch and formant frequency? Why LPC is so widely used to model speech signal? **5**
- B** The speech signal is sampled at a rate of 16,000 samples per second. A 25ms frame is used for short time spectral analysis and window is moved by 12.5 ms in consecutive analysis frame. Assume radix 2 FFT is used to compute DFT. **3**
- i. What is the frame rate?
  - ii. What size of DFT and FFT are required to guarantee that no time aliasing will occur?
  - iii. What is frequency resolution between adjacent samples?
- C** Define the following frame level features of speech with suitable mathematical expressions. **2**
- i. Zero Crossing Rate
  - ii. Short Time Energy
- Q2 A** Draw a block diagram and explain the bank of filters analysis method for speech signal. **4**
- B** Write an overall algorithm for comparing input utterance with a template using Dynamic Time Warping? What do you mean by terms Synchronous DTW? **4**
- C** What is need of generating average template for each word? **2**
- Q3 A** Explain the segmental K-means algorithm for optimal segmentation for training a model using multiple templates. **3**
- B** Explain the LBG algorithm of VQ codebook generation. What are its advantages? **3**

C What are the three basic problems of HMM? Why Left to Right HMM is used for speech recognition? 4

Q 4 A Explain the forward algorithm to efficiently evaluate the probability of the a given observation sequence  $\mathbf{O}$ , generated from given hidden Markov model  $\lambda$ ,  $P(\mathbf{O}|\lambda)$ . With a suitable example estimate the number of required computations. 5

B Write important steps in Viterbi algorithm to find best state sequence for given observation sequence and model. 5

Consider an HMM representation of a coin tossing experiment. Assume three state model (corresponding to three different coins) with probabilities.

	State1	State2	State3
P(H)	0.2	0.2	0.5
P(T)	0.8	0.8	0.5

and with all state transition probabilities equal to 1/3 and with initial probabilities equal to 1/3

You have a observation sequence  $\mathbf{O}=(\mathbf{HHH TTHHTT})$

Find most likely path with the Viterbi algorithm.

Q 5 Write short note on (any two) 10

- Speaker Identification and Verification.
- Isolated Word Recognition using HMM.
- Audio Coding Standards.
- Text To Speech Conversion.

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